The Anita Borg Institute for Women and Technology presents:

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feedback and dynamics in nature
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Wednesday, October 4, 2006
8:30 am - 5:30 pm

Town and Country Resort & Convention Center
San Diego, California

ANITA BORG INSTITUTE
FOR WOMEN AND TECHNOLOGY

FOR MORE INFORMATION CONTACT

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SAVE THE DATE
Grace Hopper Celebration of Women in Computing
October 17-20, 2007
Orlando, Florida

Princeton University

UCSB

California Institute of Technology 1891

AGENDA

8:30	*Welcome*
8:45	*Opening and Framework for the day* Jean Carlson, University of California, Santa Barbara Naomi Ehrich Leonard, Princeton University Richard Murray, California Institute of Technology
10:00	*"Should Robots Mimic Fish? Biological Models of a Distributed Intelligence"* Julia Parrish, University of Washington
10:45	*Observations & Questions*
11:00	*Break*
11:30	*"Designing Biological Systems"* Pamela Silver, Harvard University
12:15	*Observations & Questions*
12:30	*Lunch, posters on display*
2:00	*Research in Interdisciplinary Science* Ralph Archuleta, University of California, Santa Barbara Margaret Martonosi, Princeton University Linda Petzold, University of California, Santa Barbara Maria Klawe, Harvey Mudd College as moderator
3:30	*"Networked Sensing Systems: From ecosystems to human systems"* Deborah Estrin, University of California, Los Angeles
4:15	Observations & Questions
4:30	Poster Session
5:30	Adjourn to Reception

WORKSHOP PRESENTER BIOGRAPHIES

Ralph Archuleta

Professor, Seismology, University of California, Santa Barbara

His primary research interest is in understanding the earthquake source process and the generation of strong ground motion—the shaking that can cause damage. He is currently the Deputy Director of the Southern California Earthquake Center. Prof. Archuleta is a former President (and Vice President) of the Seismological Society of America. He has served as Acting Director and Associate Director of the UCSB Institute for Crustal Studies. Prof. Archuleta has served on the NAS Committee on Seismology and numerous USGS External Research Panels. He has been consultant to the US Nuclear Regulatory Commission, Federal Energy Regulatory Commission, US Bureau of Reclamation on issues regarding strong ground motion and critical structures. Prof. Archuleta spent seven years at the USGS in Menlo Park before becoming an associate professor at UCSB in 1984.

Jean Carlson

Professor, Department of Physics, University of California, Santa Barbara

Jean M. Carlson received a B.S.E. in Electrical Engineering and Computer Science from Princeton University in 1984, an M.S.E. in Applied and Engineering Physics from Cornell University in 1987, and a Ph.D. in Theoretical Condensed Matter Physics from Cornell in 1988. After Postdoctoral work at the Institute for Theoretical Physics, at the University of California Santa Barbara, she joined the faculty at UCSB in 1990, where she is currently a Professor of Physics. She is a recipient of Fellowship Awards from the Sloan Foundation, the David and Lucile Packard Foundation, and the McDonnell Foundation. Carlson's research interests include a combination of foundational work and a variety of practical applications of complex systems theory, including earthquakes, wildfires, and optimization and design in networks.

Deborah Estrin

Professor, Computer Science, University of California, Los Angeles

Professor Deborah Estrin is a Professor of Computer Science at UCLA, holds the Jon Postel Chair in Computer Networks, and is Director of the NSF-funded Center for Embedded Networked Sensing (CENS). Estrin received her Ph.D. (1985) in Computer Science from the Massachusetts Institute of Technology, her M.S. (1982) from M.I.T. and her B.S. (1980) from U.C. Berkeley. Before joining UCLA she was a member of the University of Southern California Computer Science Department from 1986 through the middle of 2000. She is also a member of the Computer Networks Division at the USC Information Sciences Institute. In 1987, Professor Estrin received the National Science Foundation, Presidential Young Investigator Award for her research in network interconnection and security. During the subsequent 10 years much of her research focused on the design of network and routing protocols for very large, global, networks, such as: scalable multicast routing and transport protocols, self-configuring protocol mechanisms for scalability and robustness, and tools and methods for designing and studying large scale networks. Since the late 90's Professor Estrin has been collaborating with her colleagues and students to develop protocols and systems architectures needed to realize rapidly-deployable and robustly-operating networks of many hundreds of physically-embedded devices, e.g., sensor networks. She is particularly interested in the application of spatially and temporally dense embedded sensors to environmental monitoring. Estrin has been a co-PI on many NSF and DARPA funded projects. She chaired a 1997-98 ISAT study on sensor networks and the 2001 NRC study on Networked Embedded Computing which produced the report Embedded Everywhere. She currently chairs the Sensors and Sensor Networks subcommittee of the NEON Network Design Committee (http://neoninc.org). Estrin serves on the Advisory Committees for the NSF Computer and Information Science and Engineering (CISE) and Environmental Research and Education (ERE) Directorates. Estrin was recently selected to join the Computer Science and Telecommunications Board (CSTB) of The National Academies. Professor Estrin is a fellow of the ACM, AAAS and the IEEE. She has served on numerous panels for the NSF, National Academy of Sciences/NRC, and DARPA. She has also served as an editor for the ACM/IEEE Transactions on Networks, and as a program committee member for many networking related conferences, including Sigcomm and Infocom. She was General Co-Chair for the first ACM Conference on Embedded Networked Sensor Systems, Sensys 2003. She is also an Associate Editor for the new ACM Transactions on Sensor Networks.

Maria Klawe

President, Harvey Mudd College

Maria recently became the fifth President of Harvey Mudd College. Prior to HMC, Maria served as Dean of Engineering, and professor of Computer Science at Princeton University, held the Dean of Science, Vice-President of Student and Academic Services, and Head of Computer Science at the University of British Columbia. Maria has worked at IBM Research in California, at the University of Toronto and Oakland University. She received her Ph.D. and B.Sc. in Mathematics from the University of Alberta. Maria has made significant research contributions and currently focuses on assistive technology for people with aphasia and other cognitive impairments. Maria is a Past President of ACM, Chair of the Board of the Anita Borg Institute for Women and Technology, a Trustee of two mathematics institutes, IPAM and MSRI and a Fellow of ACM and CIPS. She is the recipient of awards including the Nico Habermann Award and several honorary doctorates.

Naomi Ehrich Leonard

Professor, Department of Mechanical and Aerospace Engineering, Princeton University

Naomi Ehrich Leonard received the B.S.E. degree in Mechanical Engineering from Princeton University in 1985. From 1985 to 1989, she worked as an engineer in the electric power industry for MPR Associates, Inc. She received the M.S. and Ph.D. degrees in Electrical Engineering from the University of Maryland, College Park, in 1991 and 1994. She is currently Professor of Mechanical and Aerospace Engineering and Associated Faculty Member of the Program in Applied and Computational Mathematics at Princeton University. Recent awards include a John D. and Catherine T. MacArthur Fellowship in 2004 and the Mohammed Dahleh Distinguished Lecture Award in 2005. Leonard's research focuses on development and application of nonlinear and geometric methods for design and analysis of dynamical systems with feedback. Current projects include coordinated control of multi-agent systems, design of mobile sensor networks, underwater gliders and adaptive ocean sampling, and collective motion and decision making in animal aggregations.

Margaret Martonosi
Professor of Electrical Engineering, Princeton University

Margaret is currently Professor of Electrical Engineering at Princeton University, where she has been on the faculty since 1994. She is also an Associate Dean for Princeton's School of Engineering and Applied Science and she holds an affiliated faculty appointment in Princeton CS. Martonosi's research interests are in computer architecture and the hardware/software interface, with particular focus on power-efficient systems and mobile computing. In the field of processor architecture, she has done extensive work on power modeling and management and on memory hierarchy performance and energy. This has included the development of the Wattch power modeling tool, the first architecture level power modeling infrastructure for superscalar processors. Her memory hierarchy work has included early performance-oriented studies, as well as more recent work on energy-aware memory hierarchies. In the field of mobile computing and sensor networks, Martonosi leads the Princeton ZebraNet project. Martonosi is co-author on over 90 refereed publications and inventor on six granted US patents. She is currently vice-chair of ACM SIGARCH. Martonosi completed her Ph.D. at Stanford University, and also holds a Master's degree from Stanford and a bachelor's degree from Cornell University, all in Electrical Engineering.

Richard Murray
Professor, Department of Control and Dynamical Systems, California Institute of Technology

Richard M. Murray received the B.S. degree in Electrical Engineering from California Institute of Technology in 1985 and the M.S. and Ph.D. degrees in Electrical Engineering and Computer Sciences from the University of California, Berkeley, in 1988 and 1991, respectively. He is currently the Thomas E. and Doris Everhart Professor of Control and Dynamical Systems and the Director for Information Science and Technology at the California Institute of Technology, Pasadena. Murray's research is in the application of feedback and control to mechanical, information, and biological systems. Current projects include integration of control, communications, and computer science in multi-agent systems, information dynamics in networked feedback systems, analysis of insect flight control systems, and synthetic biology using genetically-encoded finite state machines. Murray is currently developing a new course at Caltech that is aimed at teaching the principles and tools of control to a broader audience of scientists and engineers, with particular emphasis on applications in biology and computer science.

Julia Parrish

Associate Professor, School of Aquatic & Fishery Sciences & Biology Department, University of Washington

Her research and academic interests follow three major routes: behavior of organisms living in groups (like schools of fish and colonially nesting seabirds), seabird ecology (mainly Common Murres—a ubiquitous fish-eating coastal species in the northern hemisphere), and marine conservation. Undergraduates, graduate students, post-doctoral fellows, staff and volunteers from the University community and the general public all contribute to these projects. She is interested in why individuals live in groups (a behavioral, ecological, and evolutionary set of questions) and how gregarious organisms maintain three-dimensional structure in the face of constantly changing conditions (a traffic rule question). At the moment, they have a fish film studio set up to collect multiple digital video images of schooling fish. Once they collect 3D data on identified individuals, they plan to ask questions about conditions under which schooling rules are forced to change, or even break down. For the past ten years she has worked on nesting colonies of the densest-nesting seabird in the world, the Common Murre. During the spring and summer months, a large part of the lab spends time in Oregon, Washington and occasionally British Columbia and Alaska, monitoring colony demographics (how many birds, how many chicks produced), and recording behavioral interactions between resident species (mainly predator–prey interactions between Bald Eagles, murres, and gulls). They use the data to predict nearshore system health (seabirds as reflectors of environmental change), study the relative contributions of direct and indirect forcing on the population dynamics of murres, and design behaviorally intelligent conservation strategies for this species. Their conservation work is a grab-bag of projects and programs designed to find workable solutions to environmental problems in the marine systems of the Northwest. At present she is involved in two exciting conservation projects: The first is an attempt to design gear modifications in Northwest fisheries that maintain target species catch but significantly decrease bycatch, specifically of seabirds. The second is a citizen science program called the Coastal Observation and Seabird Survey Team (COASST). COASST monitors beachcast carcasses of marine birds in coastal Washington and Oregon. Data from this program can be used for basic science, natural resource management decision-making, and public education and involvement.

Linda Petzold

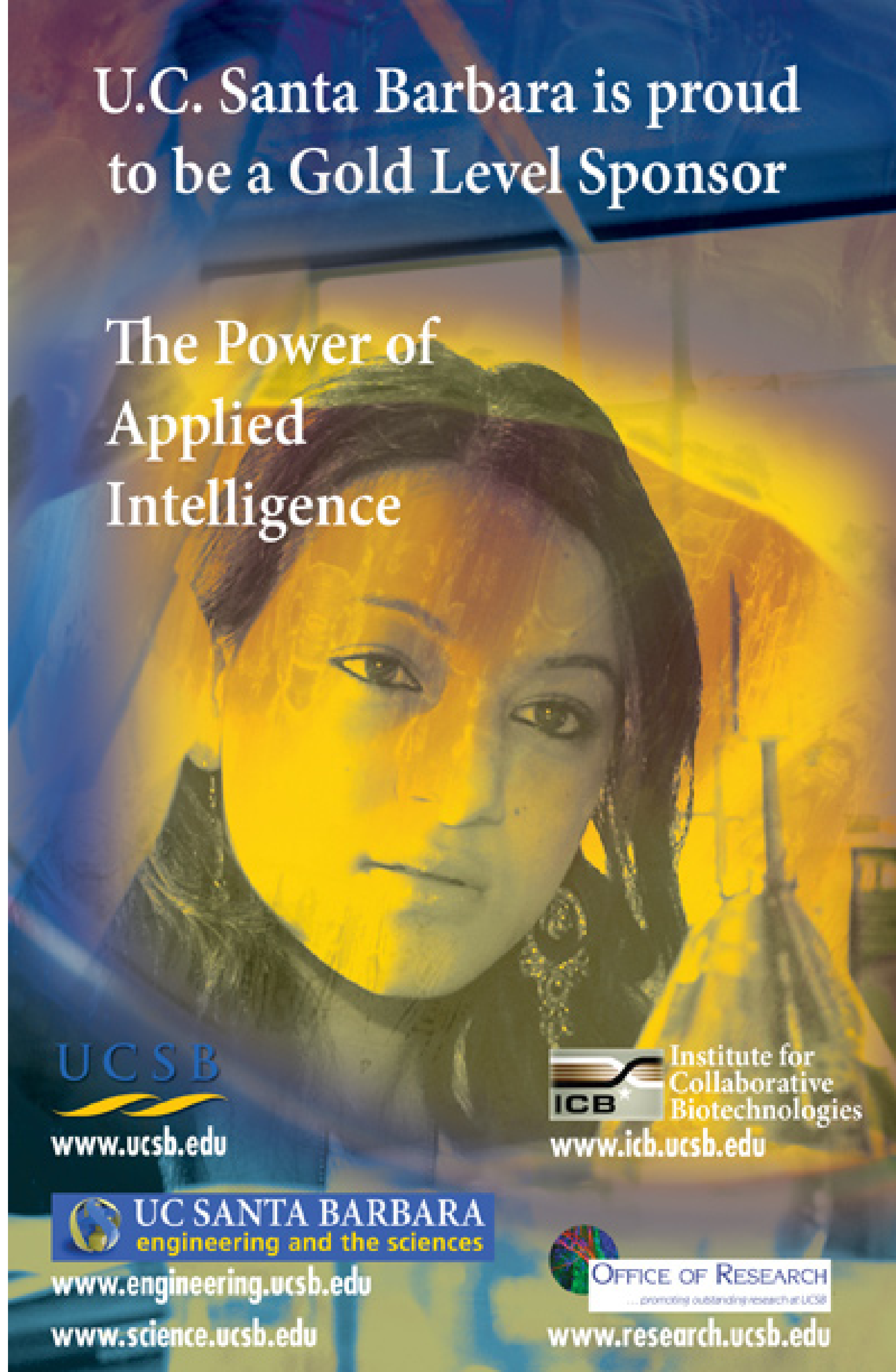
Professor, Department of Mechanical and Environmental Engineering, Department of Computer Science, University of California, Santa Barbara

Dr. Linda R. Petzold is currently Professor in the Departments of Mechanical and Environmental Engineering, and Computer Science, and Director of the Computational Science and Engineering Program at University of California Santa Barbara. She received her Ph.D. in Computer Science in 1978 from the University of Illinois. From 1978-1985 she was a member of the Applied Mathematics Group at Sandia National Laboratories in Livermore, California, and from 1985-1991 she was Group Leader of the Numerical Mathematics Group at Lawrence Livermore National Laboratory. From 1991-1997 she was Professor in the Department of Computer Science at the University of Minnesota. Dr. Petzold was awarded the Wilkinson Prize for Numerical Software in 1991, and the Dahlquist Prize, for numerical solution of differential equations, in 1999. She served as SIAM (Society for Industrial and Applied Mathematics) Vice President at Large from 2000-2001, as SIAM Vice President for Publications from 1993-1998, and as Editor in Chief of the SIAM Journal on Scientific Computing from 1989-1993. Her research interests include numerical ordinary differential equations, differential-algebraic equations, and partial differential equations, sensitivity analysis, model reduction, parameter estimation and optimal control for dynamical systems, multiscale simulation, scientific computing and problem solving environments.

Pamela Silver

Professor, Department of Systems Biology, Harvard Medical School

Pamela Silver received her BS in Chemistry from the University of California, Santa Cruz and her PhD in Biochemistry from UCLA where she was an NIH Predoctoral Fellow. She was a Postdoctoral Fellow at Harvard University in the Dept of Biochemistry and Molecular Biology where she was the recipient of Postdoctoral Fellowships from the American Cancer Society and the Medical Foundation of the Childs Memorial Fund and the Paul Glenn Institute for Aging Research. She has served on numerous editorial boards including Molecular Systems Biology, BMC Systems Biology, Genes and Development and PLoS One. She was the Editor of Molecular Biology of the Cell and was one of the early contributors to Virtual Text. Dr. Silver has served on the Council of the American Society for Cell Biology and on the Committee for Women in Cell Biology. She is currently the co-Director of the Harvard University iGEM team.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TECHNICAL POSTERS

An Oblique/Branched Fault System: Dynamic and Static Analyses

Harmony Colella, David D. Oglesby, David D. Bowman

We use a dynamic 3-D finite element analysis to investigate slip partitioning and rupture propagation on a branched fault system. The fault geometry is that of an oblique fault at depth that branches into vertical and dipping segments near the surface. We find that oblique slip on the basal fault results in partitioned slip on the near-surface faults. This result is in qualitative agreement with static models for the M=7.8 Kokoxilli, China earthquake, in which coseismic slip partitioning was observed.

Phase transitions in disordered magnets: same universality class in equilibrium and far from equilibrium?

Yang Liu, Karin Dahmen

We present numerical studies of zero-temperature Gaussian Random Field Ising Model (a model for disordered magnetic materials) in both equilibrium and non-equilibrium. We compare the no-passing rule, mean-field exponents and exponents in 3 dimensions for the equilibrium and non-equilibrium disorder induced phase transition. We show compelling evidence that these two transitions belong to the same universality class.

Dilation and Compaction of Earthquake Faults: A Constitutive Model and Its Application to Rupture Dynamics

Eric Daub

Geologic faults are filled with gouge that can dilate and compact during rupture events. We study earthquake dynamics using a constitutive law inspired by granular physics where free volume is a dynamic state variable, allowing the fault to dilate and compact. The law exhibits approximately logarithmic velocity dependence in steady- state like the Dietrich-Ruina type rate and state laws. However, the characteristic slip distance increases with dilation as observed in several laboratory experiments. This alters the slip-weakening behavior of dynamic ruptures when compared to linear slip-weakening and Dietrich-Ruina laws. Other features of events with the free volume law include more rapid acceleration of the rupture front to the limiting wave speeds and earlier nucleation of supershear rupture in mode II problems.

Feedback in insect outbreaks: from the individual to the landscape scale

Emma Despland, Barry Cooke

Eruptivity (population surges occur randomly following stochastic events) and cycling (population surges occur regularly due to a periodic process) are often considered as competing hypothesis to explain insect outbreaks. In the forest tent caterpillar, eruptivity arises because colony collective behaviour amplifies stochastic events. Population cycling occurs via landscape-level feedbacks between caterpillars and parasitoids. Feedback can therefore operate simultaneously at both the individual and landscape levels, to generate hard-to-predict emergent patterns of population dynamics.

Poroelastic Bimaterial Effects in Earthquake Rupture Dynamics

Eric M. Dunham, James R. Rice

A mismatch of elastic properties across a fault induces normal stress changes during an earthquake. Similar effects result from a mismatch of poroelastic properties (e.g., permeability) within fluid-saturated damage fringes along the fault walls; these induce changes in pore-fluid pressure on the fault and hence changes in effective normal stress during slip. We study these effects within numerical earthquake models.

Quantifying nonlinearity in time series as a means of detecting catastrophic shifts in ecosystems

Sarah M. Glaser, Chih-hao Hsieh, Andrew J. Lucas, George Sugihara

Recent studies demonstrate the possibility for large-scale regime shifts in marine ecosystems. We use statistical nonlinear forecasting techniques to analyze 14 physical and 16 biological time series from the North Pacific. Physical variables are found to be linear stochastic while biological variables have a low-dimensional nonlinear signature. Results suggest biological components of marine ecosystems have the capacity for dramatic changes in response to stochastic fluctuations in basin-scale physical states.

Extreme Programming in Wireless Sensors Networks

Lilia Kakaradova

Two fundamental questions dominate chaos control theories. The first is the problem of controlling higher-dimensional chaos in physical systems. The second question is control in a spatiotemporal system. The second question is much more important and challenging because the behaviors in spatially extended systems are extremely rich, patterns formation, traveling waves, spiral waves, turbulence, etc. The controls of such behaviors have extensive and great potential of interdisciplinary applications such as biological systems, medicine, engineering and software engineering, information processing and security communication. Our focus of study is software engineering, information processing and security communication. Through a study of wireless sensor networks as weather monitoring networks in monitoring coral bleaching as a result of global warming on Heron Island we observed that biology fieldwork generates a wealth of heterogeneous information, requiring substantial labor to coordinate and distill. One can explore larger classes of nonlinear feedback functions to control and synchronize chaos, hyperchaos as well as spatiotemporal chaos. The application is in secure communication - spatiotemporal chaotic or hyperchaotic signals are transmitted to mask a message and a synchronized receiver system is set to recover the message. Thus it may improve security and obtain a more efficient encoding of information.

Model of Somite Formation in Zebrafish: Computational Coupling of Cellular Potts Model and Differential Equations with Delays

Tanya Kazakova

In most animal species, including humans, somites form during the early-stage embryo development as a precursor for vertebrae, axial muscles and early blood vessels. Even though this process, called somitogenesis, is of crucial developmental significance, the mechanism of somite formation is not fully understood. Somitogenesis can be studied by computational coupling of the Cellular Potts Model and Lewis' model (a system of differential equations with delays).

Transient Growth for the Linearized Navier-Stokes Equations

Lina Kim

We analytically solve the linearized Navier-Stokes equations for streamwise-invariant sinusoidal shear flow. We characterize transient energy growth for this system, a mechanism which may trigger nonlinear effects that lead to sustained turbulence. This includes numerically calculating perturbations which give optimal initial and total energy growth for large enough truncations to capture the behavior of the full system. We also numerically determine Reynolds number scalings and find optimal wavenumbers for maximum transient energy growth.

Stochasticity-Induced Switching in a Schooling Model

Allison Kolpas

We study a model of self-organizing group formation which exhibits noise induced transitions between two collective states. This demonstrates that changes to behavioral rules are not necessary for groups to transition between different collective states. We characterize the transitions with an effective potential which is a function of a single coarse observable. Short bursts of appropriately initialized simulations are used to efficiently estimate the necessary population-level quantities for this characterization.

The Development of a Model of a Bacterial Phosphorelay Signal Transduction System

S. Lampoudi, R.R. Hulbert, P.A. Cotter,
L.R. Petzold

The BvgAS two-component system controls virulence in the human respiratory pathogen Bordetella pertussis, the etiological agent of whooping cough. BvgAS is unlike orthodox two-component signal transduction systems in that it employs a four step phosphorelay from the sensor protein BvgS to the response regulator BvgA, instead of the more common two step phosphotransfer. Further, B. pertussis displays at least three distinct phenotypic phases, each characterized by maximal expression of some genes and minimal expression of others. We are engaged in the development of a computational model of this signal transduction and gene expression pathway which we intend to employ in exploring several questions of biological importance. For example, what is the advantage of employing a 4-step phosphorelay instead of a 2-step phosphotransfer system? Can a 2-step phosphorelay mediate three phenotypic phases? Also, BvgAS regulates its own transcription; what is the effect of this autoregulation?

3D Simulations of Seismic and Aseismic Slip History of a Fault

Nadia Lapusta, Yi Liu

We develop methodology for three-dimensional elastodynamic simulations of seismic and aseismic slip history of a planar fault imbedded in the Earth's crust. The simulations incorporate slow tectonic loading, produce long sequences of large and small earthquakes, and resolve all stages of slip accumulation such as accelerating slip during earthquake nucleation, dynamic rupture, postseismic slip, and slow interseismic events. Our goal is to constrain earthquake physics by comparing computational results with earthquake observations.

Transition of shear cracks from sub-Rayleigh to supershear speeds

Nadia Lapusta, Yi Liu

Recent observations suggest that parts of several large earthquake ruptures may have propagated with supershear speeds. We propose new mechanisms of shear crack transition from sub-Rayleigh to supershear speeds and demonstrate these mechanisms through simulations. Currently, the supershear transition is thought to happen by the Burridge-Andrews mechanism (BAM), in which a supershear daughter crack nucleates in front of the main sub-Rayleigh Mode II crack. Supershear bursts can also be created by breaking a strong asperity. We find that, under certain conditions, crack fronts can abruptly jump from the Rayleigh-wave speed to a supershear speed, under overall prestress level that is lower than predicted by BAM.

Spectral element modeling of earthquakes on rate and state faults

Nadia Lapusta, Yoshihiro Kaneko, Jean Paul Ampuero

Earthquakes and aseismic phenomena on rate and state faults have been successfully modeled by boundary integral methods (BIM). The studies have been mostly restricted to planar faults embedded into elastic medium, due to the nature of BIM. At the same time, observations show complicated crustal structures such as layers of bulk materials, fault damage zones, and non-planar fault geometries. To include these factors, we develop a 3-D spectral element method (SEM) that incorporates laboratory-derived friction laws. Our ultimate goal is to build a SEM framework for simulating long-term deformation histories while resolving all aspects of seismic and aseismic sliding.

Experimental observations and numerical simulations of various rupture modes

Nadia Lapusta, Xiao Lu, Ares Rosakis

Until recently, it was widely accepted that shear ruptures propagate in the crack-like mode, in which each point at the interface keeps sliding until arrest waves arrive from the boundaries. However, observations show that ruptures in the Earth often propagate differently, as pulses of slip (Heaton, 1990). We experimentally observe crack-like and pulse-like rupture modes and our results can be qualitatively explained by theories that incorporate rate weakening of friction at the interface. We are in the process of conducting numerical simulations to determine whether rate weakening is indeed required to explain the experimental observations.

Stochastic Simulation Toolkit for Chemically Reacting Systems

Hong Li, Linda R. Petzold

Traditional ordinary differential equation-based approaches to simulation of chemical reacting systems fail to capture the randomness inherent in such systems at scales common in intracellular biochemical processes. We present StochKit, an efficient, extensible stochastic simulation framework developed in the C++ language that aims to make stochastic simulation accessible to practicing biologists and chemists, while remaining open to extension via new stochastic and multiscale algorithms. The current version of StochKit includes the popular Gillespie Stochastic Simulation Algorithm (SSA) Direct Method, our new Logarithmic Direct Method which is considerably faster than the original Direct Method, slow-scale SSA for multiscale problems, adaptive non-negativity preserving explicit tau-leaping, and core modules for explicit, implicit and trapezoidal tau-leaping methods. We provide a Java Converter to convert an SBML file specifying the chemical mechanism to the input files needed for our software. StochKit includes some basic tools to solve a question of great concern to developers of accelerated stochastic algorithms---how can we verify the accuracy of a stochastic solver, given the inherently random nature of stochastic simulation? The Kolmogorov distance and histogram distance for quantifying differences in statistical distribution shapes are provided in the MATLAB language. For those who need to run the Monte Carlo simulations a large number of times to collect an ensemble, we provide a convenient MPI interface enabling the Monte Carlo simulation to run on a parallel cluster.

Shear Localization as a Possible Mechanism for Velocity Weakening

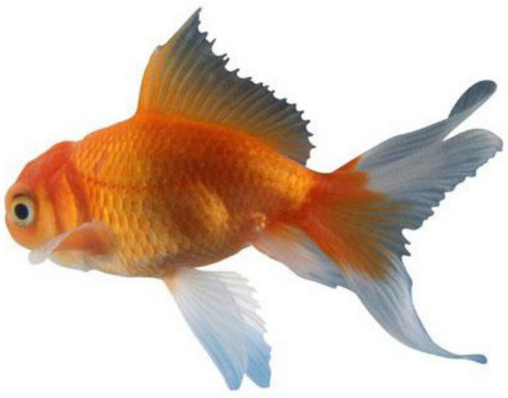
M. Lisa Manning, Jim Langer, Jean Carlson

Friction between sliding surfaces is a complex, history-dependent force that emerges from the underlying dynamics of smaller scale objects, such as granular interfacial material or plastically deforming asperities. In order to understand how small scale behavior gives rise to macroscopic friction laws, we model the behavior of granular material between fault planes using the theory of Shear Transformation Zones (STZs). This leads to equations of motion for several internal variables in addition to the velocity and stress, which we integrate numerically. We find the STZ model does permit localization of shear, which has important implications for constitutive friction laws.

Distributed algorithms for environmental boundary monitoring

Sonia Martinez, Sara Susca

We present and analyze different algorithms to monitor environmental boundaries with mobile agents. The objective is to optimally enclose the boundary through approximating polygons. The mobile sensors rely on local information to position some interpolation points to define he polygon. We employ different criteria to define the optimal placement f sensors inspired by the approximation theory of convex bodies. The lgorithms are provably convergent for static boundaries and behave well forlowly-moving boundaries.



Agile Maneuvering for Bioinspired Fin-Actuated Underwater Vehicles

Kristi A. Morgansen

Underwater locomotion and propulsion for underwater vehicles provide rich applications for the development of control methods for nonlinear systems and underactuated mechanical systems. In the work here, the tasks of modeling and control for agile gait generation for robots built with fin propulsive and maneuvering surfaces are considered. Previous work for such bioinspired devices has shown that simplified models with quasistatic lift and drag can be used to construct trajectory tracking controls for forward and turning motions that strongly resemble biomimetic motions. Here we will evaluate the use of such models for agile maneuverability tasks such as fast start and snap turn, small scale motion control, and full space coverage. Results will be demonstrated in both simulation and in experiment with the University of Washington fin-actuated autonomous underwater vehicles.

Maize Gene Expression Annotation and Analysis Database

Olga Nikolova

Microarray analyses generate large sets of raw data. A project is ongoing to analyze the genes involved in shoot apical meristem function and leaf initiation in maize. The Gene Expression Visualization Application (GENEVA) was designed to store, maintain, and facilitate the annotation process of thousands of expressed sequence tags (ESTs). GENEVA is highly searchable, allows for explorations across multiple DNA microarray chips, and presents statistical analysis of correlations in the data by functional protein categories.

Ground Motion from Potential Earthquakes in the Sea of Marmara, Turkey

David D. Oglesby

The North Anatolian Fault near Istanbul, Turkey, consists of strike-slip segments that are connected by an oblique normal fault in a large stepover. Using the 3D finite element method, we model potential earthquakes on this fault system to determine whether rupture can propagate through the stepover. We find that stress interactions between the fault segments can cause earthquakes to cascade into larger events than would otherwise be anticipated from the regional stress field alone.

Resolution of GPS data from the 2004 Mw6.0 Parkfield Earthquake

Morgan Page, Susana Custodio, Ralph Archuleta, Jean Carlson

The long-awaited 2004 Mw6.0 Parkfield Earthquake was captured by a dense array of near-field strong-motion and GPS stations. We investigate the resolution of the GPS stations, which record the static field of the earthquake. We find that even for a well-recorded earthquake such as Parkfield, static GPS inversions are poorly resolved at depth and near the edges of the fault. We demonstrate how underdetermined inversions can generate structure in poorly resolved areas that is not real.

Furthermore, we find that bootstrapping analyses are unlikely to give the correct error bounds in these regions. As such, much of the structure shown in GPS inversions of Parkfield is highly uncertain.

Robustness and Fragility in Immunosenescence

Sean P. Stromberg

We present a simple, dynamic model of immune response which incorporates a shape space description of the lymphocyte repertoire. We use this model to study the development and aging of the repertoire. Under the resource constraint on total number of lymphocytes, trade-offs from naive to memory lymphocytes leave the system adapted to chronic infections, able to rapidly generate an efficient response, but fragile to rare infections. From the model we see that the immune system becomes over-adapted after many infections. This age correlated weakness is due to the dynamics of system adaptation rather than an accumulation of defects. The adaptive immune system is seen through this theoretical framework to be an example of Highly Optimized Tolerance.

Capturing Phase Dynamics of Circadian Clocks

Stephanie R. Taylor

Vital physiological behaviors of living organisms display circadian (daily) rhythms. They are controlled by sloppy endogenous oscillators. Entraining signals, such as light, ensure the internal clocks will be in phase with the environment. To understand the clock and signaling mechanisms, we must understand their timing behavior. This poster focuses on mathematical models, using sensitivity analysis to investigate such mechanisms. We introduce the parametric Impulse Phase Response Curve (IPRC).

A Role for Spatial Modularity in Ecosystem Robustness

Colleen T. Webb

Disturbance effects are hypothesized to be limited in ecosystems with modular structure based on theory from complex adaptive system. Many disturbances in ecosystems spread spatially (e.g., fire and disease), and my results from computer simulations support the idea that an intermediate level of modularity or clustering in the spatial distribution of organisms can help to buffer against the effects of a spatially spreading disturbance and that under some conditions clustering can resolve in response to disturbance.

Distributed Decision Making: Gossip Protocols for Large-Scale

Distributed Systems Stacy Patterson

We study gossip protocols for solving two fundamental problems in large-scale distributed systems, aggregation and load balancing. In gossip protocols, each site is a decision-making agent whose actions depend only on local information, and the collection of distributed actions results in some desired global behavior. Exploiting the similarity between this formulation and formulations studied in distributed dynamical systems and cooperative control, we use distributed control methods to provide provably guaranteed convergence properties.

ANITA BORG INSTITUTE
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CHANGING THE WORLD FOR WOMEN AND FOR TECHNOLOGY…

The Anita Borg Institute is the only major organization for technical women focused entirely on development and retention of technical women leaders; whether as innovative technical thinkers, practitioners or teachers, project leaders, technical managers or executives. ABI concentrates in the areas of computer engineering, technology and related disciplines based on the belief that these are the roots of technological breakthroughs that will most benefit society as a whole.

Designed to help technical women navigate their careers from the collegiate level through senior management, an ever-expanding roster of ABI programs reaches thousands of technical women annually. Through ABI, technical women:

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- Hone communication and problem-solving skills
- Discover innovative teaching and learning techniques
- Establish powerful formal and informal networks
- Participate in mentoring

PROGRAMS THAT MAKE A DIFFERENCE

SYSTERS™ ONLINE COMMUNITY
Founded in 1987, Systers is the world's largest online community of women in computing. Since its inception, has served over 10,000 women in 58 countries. Systers recently initiated "Pass-It-On" grants program to help technical women pursue their goals. www.systers.org

GRACE HOPPER CELEBRATION OF WOMEN IN COMPUTING (GHC)
The Grace Hopper Celebration is the world's premier gathering of technical women in computing. For more than a decade through six GHC Conferences more than 4000 women have attended and more than 800 scholarships have been awarded to students. www.gracehopper.org

TECHLEADERS
Workshops bring together networks of women from industry, academia and government—both powerful technology leaders and aspiring women in technology. www.anitaborg.org/programs/techleaders

AFFILIATES
The Anita Borg Institute for Women and Technology collaborates with a variety of affiliate organizations with shared values. We invite you to become part of the Affiliate's program designed to mutually extend our reach and our shared vision. www.anitaborg.org/about/affiliates.php

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The ABI Ambassador Program is designed to encourage technical women to increase the outreach and impact of ABI programs. www.anitaborg.org/about/ambassadors.php

WOMEN OF VISION
This Anita Borg Institute event honors women from industry, academia or government who are making significant contributions in innovation, leadership and social impact. Nominees are submitted by companies, universities and private industry and the public, with one winner selected in each category. www.anitaborg.org/programs/wov Nominations open November 1st, 2006 and are due by January 3rd, 2007.

ANITA BORG AWARDS
The Annual Anita Borg Awards for Social Impact and Technical Leadership recognize outstanding leaders who embrace Anita Borg's lasting vision to change the world for women and for technology. www.anitaborg.org/programs/awards . CALL FOR NOMINATIONS OPEN SOON.

SCHOLARSHIPS
The Anita Borg Institute offers or facilitates a variety of scholarship programs such as the Systers Pass-it-On grants, Grace Hopper Scholarships, the FDN Scholarships, and the Change Agent Scholarships.

www.anitaborg.org